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ARTICLE

Intrauterine Contraception and Athletic Performance: Where is the Data?

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Abstract
Background: Oral contraceptives (OCs) represent the most popular form of female-controlled contraception among the general and athletic populations. In female athletes, OCs are often used therapeutically to treat dysmenorrhea, which is perceived by many to affect training and performance. Recently, copper intrauterine devices (IUDs) and hormonal intrauterine systems (IUSs) have increased in popularity, and are now recommended by the Canadian Paediatric Society as a first-choice contraceptive. IUDs, however, present no therapeutic benefits with respect to dysmenorrhea, and may increase physical side effects associated with the menstrual cycle. Alternatively, IUSs have therapeutic application for dysmenorrhea, and therefore may present an option for athletes looking to reduce menstrual cycle symptoms. **Purpose:** To review the effects of IUDs and IUSs on exercise and athletic performance. **Methods**: Databases were searched using MeSH terms and key words in Boolean combinations. Studies were included if they 1) used a validated assessment of exercise performance (i.e., peak oxygen uptake (VO_2peak) test, 1-repetition maximum, time to exhaustion), 2) included human participants who were moderately to very physically active (as assessed by a validated tool), and 3) used any copper IUD or hormonal IUS. **Results**: A total of 245 titles were returned from the literature review; however, no studies met the inclusion criteria. **Conclusion:** The review returned limited relevant literature, and therefore, focuses on the theoretical bases of why IUDs and IUSs should be examined in the context of exercise and athletic performance. The need for future, experimental data exploring the effects of IUDs and IUSs on exercise and athletic performance is highlighted. **Health & Fitness Journal of Canada 2020;132):37-45**.
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Introduction

Primarily intended to prevent pregnancy, a wide variety of female-controlled contraceptive methods are available over the counter and with a prescription, including: long acting reversible contraceptives (LARCs), short-acting hormonal, barrier, and contraceptive injection (U.S Food and Drug Administration, 2020). As a short-acting hormonal contraceptive, oral contraceptives (OCs) represent the most popular method of female-controlled contraception among Canadian females, with a reported 16.2% of females using OCs from 2007-2011 (Black et al., 2009; Rotermann, Dunn, & Black, 2015). In the United Kingdom, 49.5% of elite athletes report using hormonal contraceptives, with over 75% of these athletes using an OC (Martin et al., 2017). Although intended to prevent pregnancy, OCs may be used therapeutically to reduce menstrual cycle symptoms, such as blood loss and

dysmenorrhea (for review see Fraser & Kovacs, 2003), and improve cycle regularity and/or eliminate menstruation (Armstrong, 2010). In a study by Bruinvels et al. (2016), over 50% of elite athletes reported that they feel training and performance is impacted by their menstrual cycle and associated heavy menstrual bleeding. As such, OCs can be used by female athletes who are concerned about their menstrual cycle impacting training and performance (Bennell, White, & Crossley, 1999; Martin et al., 2017; Shaumberg et al., 2018).

While OCs are the most commonly used form of female-controlled contraception, other forms of contraception, such as copper intrauterine devices (IUDs) and hormonal intrauterine systems (IUSs) have become popular in recent years. From 2001-2011, OC use decreased in Canada, while intrauterine contraceptive use slightly increased (Finnsdottir & Wu, 2019). Unlike OCs, which must be taken daily (Webberley & Mann, 2003), IUDs and IUSs are considered LARCs. That is, IUDs and IUSs are effective for several years after placement, and do not require patient intervention (Canadian Paediatric Society, 2018). As of 2018, the Canadian Paediatric Society recommends intrauterine contraception as a first-choice method for contraception. Therefore, the use of IUDs and IUSs will likely increase in the adult and athletic population in the coming years.

Unlike OCs, which have therapeutic benefits, IUDs do not have benefits with respect to blood loss or dysmenorrhea. In fact, IUD users may experience side effects, such as increased pain and blood loss (see table 1; Milsom et al., 1995), although these symptoms may improve over time (Hubacher, Chen, & Park, 2009). IUSs, however, have therapeutic benefits with respect to dysmenorrhea and blood loss (Krishnamoorthy & Verma, 2017; Luukkainen & Toivonen, 1995; Stanford & Mikolajczyk, 2002). As such, IUSs represent another option for athletes looking to reduce the potential effects of the menstrual cycle on training and performance, while IUDs may negatively affect performance. Given the potential therapeutic benefits of IUSs, the potential negative effects of IUDs, and the likelihood that their use will increase in the near future, the purpose of this review was to examine existing literature exploring the effects of IUDs and IUSs on exercise and athletic performance in physically active, healthy females. Specifically, investigations examining the effects of IUD and IUS use on 1) muscular strength, 2) muscular fatigue, 3) endurance capacity, and 4) aerobic exercise performance were of interest.

Methods

Literature Search

Using Pubmed, SportDiscuss, and ScienceDirect, a literature search of English language articles was conducted in April 2020 using relevant MeSH Terms and key words in Boolean combinations: “athletic performance,” “muscle strength,” “physical endurance,” “muscular fatigue,” “aerobic exercise,” “intrauterine device,” “hormone releasing intrauterine device,” “copper intrauterine device,” “IUD,” “IUS,” “intrauterine system.” No limitation was placed on publication date or study design. Search results were then imported and amalgamated into Rayyan QCRI software (Ouzzana, Hammady, Fedorowicz, & Elmagarmid, 2016). Note: two searches containing either “intrauterine device,” “hormone releasing intrauterine device,” “copper intrauterine device,” or “IUD,” “IUS,” “intrauterine system” were

conducted in ScienceDirect due to limitations on Boolean combinations.

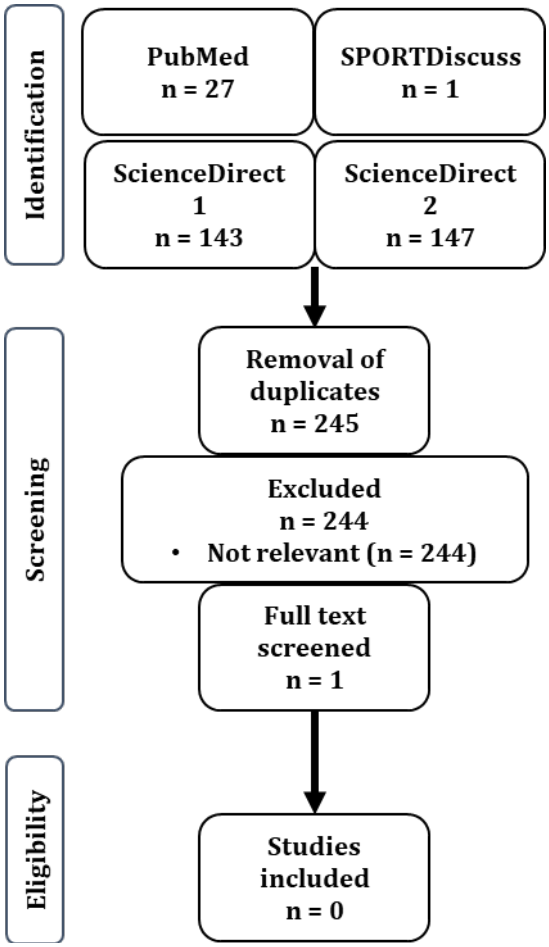
Inclusion Criteria

Studies were included if they 1) used a validated assessment of exercise performance (e.g., peak oxygen uptake (VO_2peak test), 1-repetition maximum, time to exhaustion), 2) included human participants who were moderately to very physically active (as assessed by a validated tool), and 3) participants reported using copper IUDs or hormonal IUSs. Screening of titles and abstracts were conducted using Rayyan QCFRI software (Ouzzani et al., 2016) independently by author ZJH, and LR. Any disagreements were solved by discussion, and if necessary, an independent 3rd party. Risk of bias was to be assessed for included studies using the Cochrane revised Risk-of-Bias Tool for Randomized Trials (RoB2; Sterne et al., 2019) and Risk of Bias In Non-Randomized Studies of Interventions (ROBINS-I; Sterne et al., 2016) tools.

Results

A total of 318 results were returned from the literature search. After removal of duplicates, 245 titles remained (DOI: 10.13140/RG.2.2.31612.16006). The majority of titles returned by the literature search were excluded as "not relevant" due to: animal studies, no exercise assessment, no IUD, sexual health textbook chapter, unrelated. Only one study (Suuronen et al., 2019) examined any type of exercise and/or athletic performance in humans who used IUDs or IUSs. After full-text screening, the study was excluded as it did not use a valid tool to measure physical activity levels. Therefore, no studies met the inclusion criteria for this review (Figure 1).

Figure 1. Literature review flow chart.



Discussion

The purpose of the review was to examine the effects of IUDs and IUSs on exercise and athletic performance in physically active, healthy individuals. The review failed to produce any studies that fit the inclusion criteria. Only one article (Suuronen et al., 2019) was found that met the criteria for full-text screening, although it was excluded due to its measurement of physical activity. Given the lack of studies on the topic of IUDs, IUSs, exercise and athletic performance, this study will be included for the sake of discussion. Furthermore, pertinent information regarding the menstrual cycle, IUDs, and IUSs will be discussed, along with rational

for why the effects of IUDs and IUSs should be studied in the context of exercise and athletic performance.

Although the menstrual cycle is a normal and regular occurrence for reproductive aged females, a significant portion of the female population experience unpleasant side effects related to the menstrual cycle. Termed dysmenorrhea, symptoms can include cramps in the suprapubic region (Antanao et al., 2005), as well as nausea, vomiting, headaches, irritability, loss of appetite, and weakness (Harel, 2006). Symptoms of dysmenorrhea stem from the release of prostaglandins and leukotrienes as progesterone levels decrease prior to menstruation. In turn, this results in an inflammatory response, leading to the described symptoms (Harel, 2006). As such, female athletes may opt to use contraceptives to reduce menstrual cycle symptoms and in an attempt to ameliorate their negative effects on athletic performance.

While the majority of female athletes use OCs, and may do so for their therapeutic properties (Martin et al., 2017), there is debate in the literature regarding the effects that OCs may have on athletic and exercise performance from a physiological perspective. Combination OCs contain a daily does of both estrogen and progesterone for 21 days (active phase), followed by 7 days off (inactive), although this time frame, as well as dosing from day to day can vary (Webberley & Mann, 2003). Monophasic OCs contain the same dosing of estrogen and progesterone for the active phase, whereas biphasic and triphasic OCs contain two and three different doses of estrogen and progesterone across the active phase, respectively (Webberley & Mann, 2003). High circulating estrogen levels have been suggested to reduce carbohydrate and glycogen use during submaximal exercise (Campbell, Angus, & Febbraio, 2001; D'Eon et al., 2002, Ruby et al., 1997) while increasing fatty acid oxidation (D'Eon et al., 2002), and increasing arterial vasodilation (Mendelsohn, 2002). Theoretically, estrogen associated with OC use would facilitate improved performance during endurance exercise; however, progesterone has been shown to exert "antiestrogenic" effects. That is, progesterone may blunt the effects of estrogen on carbohydrate and fatty acid oxidation (D'eon et al., 2002). As such, the potential benefits of exogenous estrogen on exercise performance may be negated by exogenous progesterone.

Research examining the effects of OCs directly on performance measures has produced conflicting results; however, modern monophasic OCs appear to not affect aerobic capacity (for review see Burrows & Peters, 2007, Mattu et al., 2019). Indeed, this may support the hypothesis that the progesterone found in OCs is exerting antiestrogenic effects. Significant reductions in VO_2peak have been reported in athletes and active individuals when taking triphasic OCs (Casazza et al., 2002; Jacobs et al., 2005; Lebrun et al., 2003). An exact mechanism to explain these reductions is unclear, although it is thought that suppression of endogenous estrogen and progesterone by exogenous estrogen and progesterone may play a role (Burrows & Peters, 2007, Casazza et al., 2002). Irrespective of the mechanisms involved, based on the observed reductions in VO_2peak, it has been suggested that athletes involved in aerobic based sports avoid triphasic OCs (Burrows & Peters, 2007).

In the only study to be fully screened for this review, Suuronen et al. (2018) conducted a cross-sectional study of OCs,

IUSs, and other contraceptives' effects on muscle strength and body composition. Four-hundred young females were included in the study, ranging in age from 20-40 years. Approximately 35% of participants used a combination hormonal contraceptive (OC or vaginal ring), while approximately 11% used an IUS. IUS users had a significantly higher BMI, greater body fat percentage, and less relative muscle mass than non-contraceptive users when adjusted for physical activity, age, alcohol use, health, smoking, and pregnancies. OC users had significantly less muscle mass and less grip strength compared to non-contraceptive users when controlling for co-variates. As a cross-sectional study, these results should be interpreted cautiously, although it would appear that both IUSs and combined OCs may affect body composition. Furthermore, only oral contraception significantly decreases grip strength. As grip strength is associated with other measures of strength (Wind et al., 2010), the decrease in grip strength observed in this study could be indicative of an overall decrease in strength from OC use, though this is speculative.

In Canada, IUDs and IUSs were the only form of LARCs approved until 2020. Although it is unclear if OCs affect athletic performance (Burrows & Peters, 2007), IUSs may present a therapeutic alternative for athletes who are concerned about the potential impact of combination OCs and exogenous hormones on athletic performance. While IUSs are hormone containing, they do not release estrogen. Rather, IUSs release a daily 20 microgram (or less) dose of progesterone (Stanford & Mikolajczyk, 2002; Zhu et al., 1999). Interestingly, Martin et al. (2017) reported that progesterone only OC users experienced more negative side effects than combined estrogen-progesterone OCs. IUSs, however, contain much less progesterone than OCs, which can contain over 100 μg of progesterone per dose (Stewart & Black, 2015). This difference in progesterone dose is reflected in serum progesterone levels; IUS users serum levels range from 0.5-1.3 nmol/l (Zhu et al., 1999, Raudaskoski et al., 1995), whereas OCs users serum levels are higher at 2 nmol/l (Rechichi & Dawson, 2009). Without estrogen and high levels of progesterone, the potential effects of IUSs on substrate metabolism, and consequent effects on physiological performance may be reduced. Furthermore, despite providing a lower dose of progesterone and no estrogen, IUSs have been shown to reduce symptoms of dysmenorrhea, regulate cycles, and decrease blood loss (Krishnamoorthy & Verma, 2017), which are some of the reasons athletes typically use OCs. As demonstrated by this review, no research has determined the impact of IUS use on objective or perceived athletic performance. As such, it is unknown if exercise or athletic performance is affected by IUSs.

Theoretically, IUSs may provide performance benefits that are not likely for IUDs. As previously mentioned, IUDs may increase pain and blood loss associated with menstruation, at least in the short term (Milsom et al., 1995). In athletic, non-hormonal contraceptive users, Martin et al. (2017) reported that side effects, such as cramps and headaches were most prevalent during the first 2 days of menstruation. Furthermore, 25% of these athletes experienced side effects in the week prior to, and after menstruation. Given that IUDs are likely to increase menstrual symptoms already experienced by non-hormonal contraceptive users (Milsom et al., 1995), their use would likely

Table 1: Common contraindications and side effects of intrauterine and oral contraceptives. Adapted from United States Food and Drug Administration (2019), Bayer HealthCare Pharmaceuticals (2008), Ortho-McNeil Pharmaceutical, Inc.(n.d). ^Copper IUDs only.

Intrauterine Contraceptives	
Contraindications	
	Common side effects
• Pregnancy	• Discomfort during placement
• Congenital/acquired uterine anomaly	• Changes in bleeding
• Acute pelvic inflammatory disease	• Expulsion
• Post partum endometritis	• Missed periods
• Uterine/cervical neoplasia	• Severe menstrual pain^
• Genital bleeding	• Ovarian cysts
• Acute cervicitis or vaginitis	**Uncommon side effects**
• Acute liver disease/tumour	• Uterus perforation
• Hypersensitivity to components	• Embedment
• Carcinoma of the breast	• Infection
• Wilson's disease^	• Pelvic inflammatory disease
Oral Contraceptives	
Contraindications	
	Common side effects
• Smoke	• Nausea
• Arterial or venous thrombotic disease	• Vomiting
• Diabetes	• Weight gain
• Headaches/migraines	• Increased bleeding
• History of breast cancer	• Breast tenderness
• Liver tumors or disease	**Uncommon side effects**
• Abnormal uterine bleeding	• Blood clots
• Hypersensitivity to any components	• High blood pressure
	• Liver tumours

increase discomfort and perceived effect of performance. Furthermore, 4.2% of athletes reported that they avoid exercise completely at some point during their menstrual cycle due to dysmenorrhea (Martin et al., 2007). Thus, due to the side effects of IUDs, their use as a therapeutic would not be indicated for these individuals, as it may result in reduced exercise and/or training capacity.

Although IUDs may not appear to be therapeutically beneficial, they present a non-hormonal option for contraception. While the majority of OC and IUS users report positive side effects, such as cycle regulation, reduced blood loss, and reduced pain(Fraser & Kovacs, 2003), a small number of users may experience hormone related side effects, such as weight gain, migraines, acne, mood swings, or more serious side effects, such as venous thromboembolism, hypertension, or interaction with other medications (Bitzer & Simon, 2011). In endurance and weight

class sports, weight gain may be detrimental to performance (Spanno et al., 2016). Furthermore, hormonal contraception is contraindicated in a number of conditions (Table 1). As such, IUDs may be the best and/or only option for female-controlled contraception in some individuals. In turn, this should not preclude IUDs from research with respect to the effects on athletic performance. Rather, given the reported side effects of increased menstrual pain and blood loss (Milsom et al., 1995), and subjective reports of their effects on athletic performance (Bruinvels et al., 2016), research should objectively determine the effects that IUDs and their related side effects may have on athletic performance.

Conclusions

Within sport and exercise science research, it is well recognized that females are significantly underrepresented in the literature (Costello, Bieuzen, & Blealey, 2014). As demonstrated by this review, the effects of IUSs and IUDs on athletic performance represents another area where research is needed. Female athletes have unique requirements compared to males, in that they must manage the effects of the menstrual cycle and associated hormonal perturbation with their training and competition schedule (Martin et al., 2017). Despite their common use, little is known of the effects of IUDs and IUSs on athletic performance. Furthermore, IUSs may be used to alleviate menstrual cycle symptoms, which many females already perceive to affect performance; however, it is unknown if this is the case.Given the likely increasing prevalence of IUD and IUS use in the future, experimental research is exceedingly warranted in this area.

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Authors' Qualifications

The authors' qualifications are as follows: Zachariah J. Henderson MSc, PhD(c), Trisha D. Scribbans CAT(C), PhD.

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